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→ Design and implementation of generics for the .NET Common language runtime

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↑ ABSTRACT

The Microsoft.NET Common Language Runtime provides a shared type system, intermediate language and dynamic execution environment for the implementation and inter-operation of multiple source languages. In this paper we extend it with direct support for parametric polymorphism (also known as generics), describing the design through examples written in an extended version of the C# programming language, and explaining aspects of implementation by reference to a prototype extension to the runtime.










Our design is very expressive, supporting parameterized types, polymorphic static, instance and virtual methods, "F-bounded" type parameters, instantiation at pointer and value types, polymorphic recursion, and exact run-time types. The implementation takes advantage of the dynamic nature of the runtime, performing just-in-time type specialization, representation-based code sharing and novel techniques for efficient creation and use of run-time types.


Early performance results are encouraging and suggest that programmers will not need to pay an overhead for using generics, achieving performance almost matching hand-specialized code.

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S46	69	717/106.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il) and (class or object)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:14

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S47	1	717/106.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:22
S48	3	717/106.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:25
S49	7	717/108.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:38
S50	6	S49 not S48	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:25
S51	3	717/118.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/01/03 08:19
S52	2	717/136.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:44
S53	1	717/140.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:45
S54	1	717/143.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:45

EAST Search History

S55	0	717/144.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:45
S56	2	717/146.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:46
S57	101429	"visual j#" pr	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:46
S58	15	".net" or "visual j#" or "visual j# .net"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:01
S59	1936	cil or smil	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:00
S60	1177	cil or msil	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:01
S61	158	(".net" or "visual j#" or "visual j# .net" or net) and (cil or msil)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:02
S62	130	(".net" or "visual j#" or "visual j# .net" or net) and (cil or msil) not microsoft.as.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:02
S63	787	((generic near3 class) or (templat\$3 near3 class)) and (parameter\$7 or declar\$5) same (intermediate or compil\$5 or il or tree)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/01/03 09:28

EAST Search History

S64	39	((generic near3 class) or (templat\$3 near3 class)) and (parameter\$7 or declar\$5) same (intermediate or compil\$5 or il or cil or tree or (language near2 neutral) or "intermediate language" or common) and ("virtual machine" or "runtime engine") and ((type or generic) near2 class) and ((unconstrain\$3 or constructed) near3 (type or class)) and (instantiat\$3 near3 (value or argument or parameter or type))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/01/03 08:34
S65	37	((generic near3 class) or (templat\$3 near3 class)) and (parameter\$7 or declar\$5) same (intermediate or compil\$5 or il or cil or tree or (language near2 neutral) or "intermediate language" or common) and ("virtual machine" or "runtime engine") and ((type or generic) near2 class) and ((unconstrain\$3 or constructed) near3 (type or class)) and (instantiat\$3 near3 (value or argument or parameter or type)) not microsoft.as.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/01/03 08:35
S66	36	("6063128").URPN.	USPAT	OR	OFF	2007/01/03 08:49
S67	34	("6063128").URPN. not microsoft.as.	USPAT	OR	OFF	2007/01/03 09:15
S68	1	"6760905".pn.	USPAT	OR	OFF	2007/01/03 09:15
S69	2	("6760905").URPN.	USPAT	OR	OFF	2007/01/03 09:15
S70	21	("5555415" "5632035" "5715460" "5724589" "5761502" "5822583" "5838918" "5864700" "6032152" "6138171" "6195794" "6275957" "6336139" "6405368" "6598225" "6601193" "6675228" "6760905" "6826761" "6829771" "6889373").PN. OR ("7100167").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2007/01/03 09:21
S71	10759	(generat\$3 or creat\$3 or develop\$4 or pars\$3) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree))	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:25

EAST Search History

S72	11785	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree))	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:26
S73	6831	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:29
S74	438	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine") and ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class))	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:30
S75	157	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine") and ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and 717/???.cccls.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:31

EAST Search History

S76	143	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine") and ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and 717/???ccls. not microsoft.as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:31
S77	117	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine") and ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and 717/???ccls. not microsoft.as. and "source code"	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:07
S78	3450	((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and (queue or dictionary or stack)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:08
S79	141249	((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and (queue or dictionary or stack) (first and second) near3 source	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:09
S80	244	((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and (queue or dictionary or stack) and (first and second) near3 source	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:09
S81	6	defin\$5 near3 (parameter or argument or value) same ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and (queue or dictionary or stack) and (first and second) near3 source	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:43
S82	1	"6760905".pn.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:43

EAST Search History

S83	2	("6760905").URPN.	USPAT	OR	OFF	2007/01/03 13:44
S84	21	("5555415" "5632035" "5715460" "5724589" "5761502" "5822583" "5838918" "5864700" "6032152" "6138171" "6195794" "6275957" "6336139" "6405368" "6598225" "6601193" "6675228" "6760905" "6826761" "6829771" "6889373").PN. OR ("7100167"). URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2007/01/03 13:45
S85	16	gj same type same parameter	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 11:16
S86	83	ecma and (cli or clr)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 11:17
S87	52	ecma and (cli or clr) not microsoft. as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 11:35
S88	32	ecma and (cli or clr) not microsoft. as. and (intermediate or neutral)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 11:18
S89	0	("2004/0064830").URPN.	USPAT	OR	OFF	2007/01/08 11:34
S90	0	bracha.in. and gj	USPAT	OR	OFF	2007/01/08 11:34
S91	13	ecma and (cli or clr) not microsoft. as. and (JAVA and "J#")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:44
S92	0	codebricks	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:46
S93	8	attardi.in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:47
S94	21	cisternino.in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:48
S95	1	"re parser"	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:49
S96	194	"reml"	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:50
S97	2857	generat\$5 same cil	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:54

EAST Search History

S98	12	generat\$5 same cil and (generic\$5 or parameteriz\$5 or shell or templat\$2) near3 (class or object)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:15
S99	3735	generat\$5 same (common or intermediate or cil) and (generic\$5 or parameteriz\$5 or shell or templat\$2 or "parametric polymorphism") near5 (class or object)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:19
S10 0	0	(java and ".net" and "j#")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:19
S10 1	2521	generat\$5 same (common or intermediate or cil) and (generic\$5 or parameteriz\$5 or shell or templat\$2 or "parametric polymorphism") near5 (class or object) and (java or ".net" or "j#")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:20
S10 2	179	generat\$5 same (common or intermediate or cil) same (generic\$5 or parameteriz\$5 or shell or templat\$2 or "parametric polymorphism") near5 (class or object) and (java or ".net" or "j#")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:20
S10 3	171	generat\$5 same (common or intermediate or cil) same (generic\$5 or parameteriz\$5 or shell or templat\$2 or "parametric polymorphism") near5 (class or object) and (java or ".net" or "j#") not microsoft.as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:28
S10 4	12	(devillers and sylvain).in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:29
S10 5	4	(devillers and sylvain).in. and object and tree and generic	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:49
S10 6	3236778	"6760905".pn. nd (source or library or dll)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:50
S10 7	1	"6760905".pn. and (source or library or dll)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:58
S10 8	1	"6760905".pn. and (defin\$3 near3 parameter)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 17:07
S10 9	1	"6760905".pn. and (queue or dictionary or stack or list)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 17:12

EAST Search History

S11 0	1	"6760905".pn. and (edit\$3 or modify or modification or modify\$3)	US-PGPUB; OR USPAT; USOCR	ON	2007/01/08 17:17
S11 1	0	"6760905".pn. and (library or dll)	US-PGPUB; OR USPAT; USOCR	ON	2007/01/08 17:20
S11 2	165	msil	US-PGPUB; OR USPAT; USOCR	ON	2007/01/09 09:34
S11 3	114	msil not microsoft.as.	US-PGPUB; OR USPAT; USOCR	ON	2007/01/09 09:53
S11 4	17	("6412107" "6823504" "6327702" "6484313" "5740441" "6295642" "5668999" "6205577" "5768593"). pn. "20040083467" "20030084271" "20040098731" "20030182457" "20030120824" "20020120719" "20010047394"	US-PGPUB; OR USPAT; USOCR	ON	2007/01/09 10:05
S11 5	5	(eya			

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1965	(interoperability or interoperation or "multiple source languages") and intermediate and (generic\$4 or parameterized or polymorphic\$4)	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 15:20
L2	5	(interoperability or interoperation or "multiple source languages") same intermediate same (generic\$4 or parameterized or polymorphic\$4) and (bytecode or "byte code" or java or "net")	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 14:54
L3	4	(andrew adj kennedy).in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 14:55
L4	0	(donald adj syne).in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 15:10
L5	0	(don adj syne).in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 15:13
L6	167	java and tiger	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 15:13
L7	62	java and tiger and generic	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 15:20
L8	2739	(interoperability or interoperation or "multiple source languages") and (generic\$4 or parameterized or polymorphic\$4 or option\$4) and (compil\$5 or pars\$3 or tree or ast or intermediate) and (bytecode or "byte code" or java)	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 15:34
L9	2	("6760905" "6018628").pn.	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 15:32
L10	15	("5361351" "5600838" "5761511" "5864700" "5901314" "5940616" "5960197" "6032152" "6041179" "6073129" "6078744" "6151703" "6185609").PN. OR ("6760905").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2007/06/19 15:33
L11	12	("5339434" "5896522").PN. OR ("6018628").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2007/06/19 15:34

EAST Search History

L12	8	(interoperability or interoperation or heterogeneous or ((multiple or plurality) near3 (source or languages))) and (I10 or I11)	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 16:13
L13	0	cil and (I10 or I11)	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 15:41
L14	0	common adj (il or intermediate) and (I10 or I11)	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 16:12
L15	4	(interoperability or interoperation or heterogeneous or ((multiple or plurality) near3 (source or languages))) and curl.as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 16:14
L16	17	compil\$5 and curl.as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 16:25
L17	182	(cil or "common language runtime" or (common adj IL)) and (((plurality or variety or multiple or integration) near2 language) or "inter-operability" or interoperability or interoperable "multi-language" or "multi language") and (parameterized or parametric\$4 or polymorph\$6 or generic\$4 or (option\$4 near2 value) or (late near3 bind\$3))	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 17:28
L18	4	(cil or "common language runtime" or clr or (common adj IL)) and (((plurality or variety or multiple or integration) near2 language) or "inter-operability" or interoperability or interoperable "multi-language" or "multi language" or (different near3 language) or (integrat\$3 near3 language)) and (parameterized or parametric\$4 or polymorph\$6 or generic\$4 or (option\$4 near2 value) or (late near3 bind\$3)) and (net adj compil\$5) not microsoft.as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 17:35
L19	3	"20040230958" "20050060695"	US-PGPUB; USPAT; USOCR	OR	ON	2007/06/19 17:35
S1	0	Gadre.in. and "compiling source code using generic classees"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:37

EAST Search History

S2	2	"source code interoperability" and "generic class"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:38
S3	23	"source code interoperability"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:40
S4	1354	"generic class"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:38
S5	204	"generic class" and (java or bytecode)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:23
S6	115	"generic class" and (java or bytecode) and intermediate	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:39
S7	184	"generic class" and (java or bytecode) and (intermediate or tree or "object model" or token\$7 or neutral\$3)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:49
S8	2	S3 and S7	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:40
S9	22	"source code interoperability" and (tree or intermediate or "object model".)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:41
S10	22	"source code interoperability" and (tree or intermediate or "object model") and (java or bytecode or net or ".net")	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:42

EAST Search History

S11	84	"generic class" and (java or bytecode) and (intermediate or tree or "object model" or token\$7 or neutral\$3 or il or cil or msil) and (interop\$7 or "virtual object" or oopl or "multi source code" or obje)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:24
S12	82	S11 not S3	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 17:52
S13	10	(defin\$3 or definition) near3 "generic class" and (java or bytecode)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 18:18
S14	12	(defin\$3 or definition) near3 "generic class" and framework	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 18:18
S15	6	S13 and S14	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 18:24
S16	4	S13 not S15	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 18:26
S17	6	S14 not S15	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/12 18:26
S18	8	(compil\$5 or transform\$5 or adapt\$3 or wrap\$4 or translat\$3) near2 "generic class" and (java or bytecode)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 08:01
S19	9	("6018628").URPN.	USPAT	OR	OFF	2006/07/13 07:54
S20	0	(compil\$5 or transform\$5 or adapt\$3 or wrap\$4 or translat\$3) near2 "template class" and generic and (java or bytecode)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 08:01

EAST Search History

S21	0	(compil\$5 or transform\$5 or adapt\$3 or wrap\$4 or translat\$3) near5 "template class" and generic and (java or bytecode)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 08:01
S22	38	(compil\$5 or transform\$5 or adapt\$3 or wrap\$4 or translat\$3) same ((generic or template) adj class) and (java or bytecode)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 08:02
S23	30	S22 not S18	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 08:45
S24	12	("6032152" "5960197" "6151703" "5600838" "5901314" "6760905"). pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 08:46
S25	6	("6032152").URPN.	USPAT	OR	OFF	2006/07/13 08:49
S26	320	"generic object" and (java or bytecode)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:23
S27	0	generic near2 (class or object or oo or template) and (java or bytecode) and (intermediate or tree or "object model" or token\$7 or neutral\$3 or il or cil or msil) and (interoper\$7 or "multi source code" or obje) and (compil\$5 or transform\$5 or adapt\$3 or wrap\$4 or translat\$3) and paramter\$7 near3 (class or object or oo or template)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:27
S28	0	generic near5 (class or object or oo or template) and (java or bytecode) and (intermediate or tree or "object model" or token\$7 or neutral\$3 or il or cil or msil) and (compil\$5 or transform\$5 or adapt\$3 or wrap\$4 or translat\$3) and paramter\$7 same (class or object or oo or template)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:28

EAST Search History

S29	0	generic\$4 near5 (class or object or oo or template) and (java or bytecode) and (intermediate or tree or "object model" or token\$7 or neutral\$3 or il or cil or msil) and (compil\$5 or transform\$5 or adapt\$3 or wrap\$4 or translat\$3) and paramter\$7 same (class or object or oo or template)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:28
S30	12	generic\$4 and (class or object or oo or template) and (java or bytecode) and (intermediate or tree or "object model" or token\$7 or neutral\$3 or il or cil or msil) and (compil\$5 or transform\$5 or adapt\$3 or wrap\$4 or translat\$3) and paramter\$7 and (class or object or oo or template)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:35
S31	454	717/106.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 10:12
S32	448	717/108.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:35
S33	291	717/118.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:36
S34	534	717/136.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:36
S35	574	717/140.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:36
S36	294	717/143.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:36

EAST Search History

S37	170	717/144.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:37
S38	268	717/146.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:37
S39	83	717/147.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:38
S40	29	717/147.ccls. and generic\$4	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:40
S41	59	717/147.ccls. and (generic\$4 or parameter\$7)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:40
S42	15	717/147.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work")	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 09:41
S43	2	("6609248").URPN.	USPAT	OR	OFF	2006/07/13 09:50
S44	96	717/106.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work")	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 10:12
S45	69	717/106.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/07/13 10:13
S46	69	717/106.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il) and (class or object)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:14

EAST Search History

S47	1	717/106.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:22
S48	3	717/106.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:25
S49	7	717/108.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:38
S50	6	S49 not S48	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:25
S51	3	717/118.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/01/03 08:19
S52	2	717/136.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:44
S53	1	717/140.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:45
S54	1	717/143.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:45

EAST Search History

S55	0	717/144.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:45
S56	2	717/146.ccls. and (generic\$4 or parameter\$7) and (framework or "frame work") and (pars\$3 or tree or intermediate or il or compil\$5) and (class or object) and (parameter near5 generic)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:46
S57	101429	"visual j#" pr	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 10:46
S58	15	".net" or "visual j#" or "visual j# . net"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:01
S59	1936	cil or smil	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:00
S60	1177	cil or msil	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:01
S61	158	("net" or "visual j#" or "visual j# . net" or net) and (cil or msil)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:02
S62	130	("net" or "visual j#" or "visual j# . net" or net) and (cil or msil) not microsoft.as.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/07/13 12:02
S63	787	((generic near3 class) or (templat\$3 near3 class)) and (parameter\$7 or declar\$5) same (intermediate or compil\$5 or il or tree)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/01/03 09:28

EAST Search History

S64	39	((generic near3 class) or (templat\$3 near3 class)) and (parameter\$7 or declar\$5) same (intermediate or compil\$5 or il or cil or tree or (language near2 neutral) or "intermediate language" or common) and ("virtual machine" or "runtime engine") and ((type or generic) near2 class) and ((unconstrain\$3 or constructed) near3 (type or class)) and (instantiat\$3 near3 (value or argument or parameter or type))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/01/03 08:34
S65	37	((generic near3 class) or (templat\$3 near3 class)) and (parameter\$7 or declar\$5) same (intermediate or compil\$5 or il or cil or tree or (language near2 neutral) or "intermediate language" or common) and ("virtual machine" or "runtime engine") and ((type or generic) near2 class) and ((unconstrain\$3 or constructed) near3 (type or class)) and (instantiat\$3 near3 (value or argument or parameter or type)) not microsoft.as.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/01/03 08:35
S66	36	("6063128").URPN.	USPAT	OR	OFF	2007/01/03 08:49
S67	34	("6063128").URPN. not microsoft.as.	USPAT	OR	OFF	2007/01/03 09:15
S68	1	"6760905".pn.	USPAT	OR	OFF	2007/01/03 09:15
S69	2	("6760905").URPN.	USPAT	OR	OFF	2007/01/03 09:15
S70	21	("5555415" "5632035" "5715460" "5724589" "5761502" "5822583" "5838918" "5864700" "6032152" "6138171" "6195794" "6275957" "6336139" "6405368" "6598225" "6601193" "6675228" "6760905" "6826761" "6829771" "6889373").PN. OR ("7100167").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2007/01/03 09:21
S71	10759	(generat\$3 or creat\$3 or develop\$4 or pars\$3) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree))	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:25

EAST Search History

S72	11785	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree))	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:26
S73	6831	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:29
S74	438	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine") and ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class))	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:30
S75	157	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine") and ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and 717/???cccls.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:31

EAST Search History

S76	143	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine") and ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and 717/???ccls. not microsoft.as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 09:31
S77	117	(generat\$3 or creat\$3 or develop\$4 or pars\$3 or compil\$5) near3 ("intermediate language" or li or cil or ((intermediate or common or neutral) near3 (language or code or object or tokens or nodes or tree)) or (pars\$3 near3 tree)) and (java or ".net" or "j#" or "virtual machine" or "runtime engine") and ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and 717/???ccls. not microsoft.as. and "source code"	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:07
S78	3450	((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and (queue or dictionary or stack)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:08
S79	141249	((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and (queue or dictionary or stack) (first and second) near3 source	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:09
S80	244	((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and (queue or dictionary or stack) and (first and second) near3 source	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:09
S81	6	defin\$5 near3 (parameter or argument or value) same ((generic near3 class) or (templat\$3 near3 class) or (parameter\$7 near3 class) or (shell near3 class)) and (queue or dictionary or stack) and (first and second) near3 source	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:43
S82	1	"6760905".pn.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/03 13:43

EAST Search History

S83	2	("6760905").URPN.	USPAT	OR	OFF	2007/01/03 13:44
S84	21	("5555415" "5632035" "5715460" "5724589" "5761502" "5822583" "5838918" "5864700" "6032152" "6138171" "6195794" "6275957" "6336139" "6405368" "6598225" "6601193" "6675228" "6760905" "6826761" "6829771" "6889373").PN. OR ("7100167"). URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2007/01/03 13:45
S85	16	gj same type same parameter	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 11:16
S86	83	ecma and (cli or clr)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 11:17
S87	52	ecma and (cli or clr) not microsoft. as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 11:35
S88	32	ecma and (cli or clr) not microsoft. as. and (intermediate or neutral)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 11:18
S89	0	("2004/0064830").URPN.	USPAT	OR	OFF	2007/01/08 11:34
S90	0	bracha.in. and gj	USPAT	OR	OFF	2007/01/08 11:34
S91	13	ecma and (cli or clr) not microsoft. as. and (JAVA and "J#")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:44
S92	0	codebricks	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:46
S93	8	attardi.in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:47
S94	21	cisternino.in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:48
S95	1	"re parser"	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:49
S96	194	"rem1"	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:50
S97	2857	generat\$5 same cil	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 14:54

EAST Search History

S98	12	generat\$5 same cil and (generic\$5 or parameteriz\$5 or shell or templat\$2) near3 (class or object)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:15
S99	3735	generat\$5 same (common or intermediate or cil) and (generic\$5 or parameteriz\$5 or shell or templat\$2 or "parametric polymorphism") near5 (class or object)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:19
S10 0	0	(java and ".net" and "j#")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:19
S10 1	2521	generat\$5 same (common or intermediate or cil) and (generic\$5 or parameteriz\$5 or shell or templat\$2 or "parametric polymorphism") near5 (class or object) and (java or ".net" or "j#")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:20
S10 2	179	generat\$5 same (common or intermediate or cil) same (generic\$5 or parameteriz\$5 or shell or templat\$2 or "parametric polymorphism") near5 (class or object) and (java or ".net" or "j#")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 15:20
S10 3	171	generat\$5 same (common or intermediate or cil) same (generic\$5 or parameteriz\$5 or shell or templat\$2 or "parametric polymorphism") near5 (class or object) and (java or ".net" or "j#") not microsoft.as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:28
S10 4	12	(devillers and sylvain).in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:29
S10 5	4	(devillers and sylvain).in. and object and tree and generic	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:49
S10 6	3236778	"6760905".pn. nd (source or library or dll)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:50
S10 7	1	"6760905".pn. and (source or library or dll)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 16:58
S10 8	1	"6760905".pn. and (defin\$3 near3 parameter)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 17:07
S10 9	1	"6760905".pn. and (queue or dictionary or stack or list)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 17:12

EAST Search History

S11 0	1	"6760905".pn. and (edit\$3 or modify or modification or modify\$3)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 17:17
S11 1	0	"6760905".pn. and (library or dll)	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/08 17:20
S11 2	165	msil	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/09 09:34
S11 3	114	msil not microsoft.as.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/09 09:53
S11 4	17	("6412107" "6823504" "6327702" "6484313" "5740441" "6295642" "5668999" "6205577" "5768593"). pn. "20040083467" "20030084271" "20040098731" "20030182457" "20030120824" "20020120719" "20010047394"	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/09 10:05
S11 5	5	(eyal and alaluf).in.	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/09 10:36
S11 6	1	"20030023958"	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/09 12:34
S11 7	1	"6760905".pn. and (bytecode or "byte code")	US-PGPUB; USPAT; USOCR	OR	ON	2007/01/09 12:35